

Appl. No. 10/707,444  
Amdt. dated August 31, 2005  
Reply to Office action of June 01, 2005

**Amendments to the Claims:**

This listing of claims will replace all prior versions and listings of claims in the application:

**Listing of Claims:**

- 5 1. (Currently amended) A method of integrating at least one high voltage metal oxide semiconductor (HVMOS) device and at least one Submicron metal oxide semiconductor (Submicron MOS) device on a substrate comprising:
- providing the substrate;
- forming a plurality of shallow trenches having different depths on a surface of the
- 10 substrate, the shallow trenches comprising drift shallow trenches and isolation shallow trenches; [[and]]
- forming a plurality of silicon oxide layers filling up the shallow trenches, a top of each of the silicon oxide layers being in the shape of a mushroom; and
- 15 forming two isolation ion implantation regions underneath the isolation shallow trenches to isolate the high voltage metal oxide semiconductor device and the Submicron metal oxide semiconductor device.
2. (Original) The method of claim 1 wherein a depth of the shallow trenches of the Submicron metal oxide semiconductor device is greater than a depth of the shallow
- 20 trenches of the high voltage metal oxide semiconductor device.
3. (Canceled)
4. (Original) The method of claim 3 wherein a depth of the isolation shallow trenches is
- 25 greater than a depth of the drift shallow trenches.
5. (Original) The method of claim 3 wherein two drift ion implantation regions are

Appl. No. 10/707,444  
Amdt. dated August 31, 2005  
Reply to Office action of June 01, 2005

formed underneath the drift shallow trenches in an active region of the high voltage metal oxide semiconductor device.

6. (Canceled)

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7. (Original) The method of claim 1 wherein to form a plurality of shallow trenches having different depths comprises the following steps:

forming a pad oxide layer on the surface of the substrate;

forming a silicon nitride layer on a surface of the pad oxide layer;

10 forming a first hard mask patterns on a surface of the silicon nitride layer;

performing a first etching process to remove portions of the silicon nitride layer and the substrate not covered by the first hard mask patterns to form a plurality of shallow trenches of the high voltage metal oxide semiconductor device;

forming a second hard mask patterns on the surface of the silicon nitride layer; and

15 performing a second etching process to remove portions of the silicon nitride layer and the substrate not covered by the second hard mask patterns to form a plurality of shallow trenches of the Submicron metal oxide semiconductor device.

8. (Original) The method of claim 7 wherein the first hard mask patterns are defined by a  
20 first mask produced by tooling database of at least one active region outside the Submicron metal oxide semiconductor device.

9. (Original) The method of claim 7 wherein the second hard mask patterns are defined by a second mask produced by tooling database of at least one active region of the  
25 Submicron metal oxide semiconductor device.

10. (Original) The method of claim 7 wherein to form a plurality of silicon oxide layers having the tops in the shape of a mushroom comprises the following steps:

Appl. No. 10/707,444  
Amdt. dated August 31, 2005  
Reply to Office action of June 01, 2005

performing an isotropic etching process to remove portions of the silicon nitride layer along an interface of the pad oxide layer and the silicon nitride layer;

forming a silicon oxide layer on the surface of the substrate, and the silicon oxide layer filling up the shallow trenches;

- 5 performing a chemical mechanical polishing (CMP) process to remove the silicon oxide layer above a top surface of the silicon nitride layer so that a top surface of the silicon oxide layer is aligned with the top surface of the silicon nitride layer; and  
removing the silicon nitride layer.

- 10 11. (Original) The method of claim 10 further comprising a step for forming a linear oxide layer in an inner surface of the shallow trenches after performing the isotropic etching process.

12. (Original) The method of claim 10 wherein a thickness of the silicon nitride layer  
15 removed by the isotropic etching process is 100 to 300 Å.

13. (Original) The method of claim 10 wherein the silicon oxide layer is formed by performing an atmospheric pressure chemical vapor deposition (APCVD) process.

- 20 14. (Original) The method of claim 1 wherein to form the silicon oxide layers having the tops in the shape of a mushroom is to prevent a kink effect.

15. (Currently amended) A method of integrating at least one high voltage metal oxide semiconductor (HVMOS) device and at least one Submicron metal oxide semiconductor  
25 (Submicron MOS) device on a substrate comprising:  
providing the substrate of a first conductive type;  
forming a deep well region of the Submicron metal oxide semiconductor device of a second conductive type;

Appl. No. 10/707,444  
Amdt. dated August 31, 2005  
Reply to Office action of June 01, 2005

forming a plurality of shallow trenches having different depths on a surface the substrate, the shallow trenches comprising drift shallow trenches and isolation shallow trenches; [[and]]

forming a plurality of silicon oxide layers filling up the shallow trenches, a top of  
5 each of the silicon oxide layers being in the shape of a mushroom; and

forming two isolation ion implantation regions underneath the isolation shallow trenches to isolate the high voltage metal oxide semiconductor device and the Submicron metal oxide semiconductor device.

10 16. (Original) The method of claim 15 wherein the first conductive type and the second conductive type are opposite to each other.

17. (Original) The method of claim 16 wherein the first conductive type is P type, and the second conductive type is N type.

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18. (Original) The method of claim 16 wherein the first conductive type is N type and the second conductive type is P type.

19. (Original) The method of claim 15 wherein a depth of the shallow trenches of the  
20 Submicron metal oxide semiconductor device is greater than a depth of the shallow trenches of the high voltage metal oxide semiconductor device.

20. (Canceled)

25 21. (Original) The method of claim 20 wherein a depth of the isolation shallow trenches is greater than a depth of the drift shallow trenches.

22. (Original) The method of claim 20 wherein two drift ion implantation regions are

Appl. No. 10/707,444  
Amdt. dated August 31, 2005  
Reply to Office action of June 01, 2005

formed underneath the drift shallow trenches in an active region of the high voltage metal oxide semiconductor device.

23. (Canceled)

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24. (Original) The method of claim 15 wherein to form a plurality of shallow trenches having different depths comprises the following steps:

forming a pad oxide layer on the surface of the substrate;

forming a silicon nitride layer on a surface of the pad oxide layer;

10 forming a first hard mask patterns on a surface of the silicon nitride layer;

performing a first etching process to remove portions of the silicon nitride layer and the substrate not covered by the first hard mask patterns to form a plurality of shallow trenches of the high voltage metal oxide semiconductor device;

forming a second hard mask patterns on the surface of the silicon nitride layer; and

15 performing a second etching process to remove portions of the silicon nitride layer and the substrate not covered by the second hard mask patterns to form a plurality of shallow trenches of the Submicron metal oxide semiconductor device.

25. (Original) The method of claim 24 wherein the first hard mask patterns are defined  
20 by a first mask produced by tooling database of at least one active region outside the Submicron metal oxide semiconductor device.

26. (Original) The method of claim 24 wherein the second hard mask patterns are defined by a second mask produced by tooling database of at least one active region of  
25 the Submicron metal oxide semiconductor device.

27. (Original) The method of claim 24 wherein to form a plurality of silicon oxide layers having the tops in the shape of a mushroom comprises the following steps:

Appl. No. 10/707,444  
Amdt. dated August 31, 2005  
Reply to Office action of June 01, 2005

performing an isotropic etching process to remove portions of the silicon nitride layer along an interface of the pad oxide layer and the silicon nitride layer;

forming a silicon oxide layer on the surface of the substrate, and the silicon oxide layer filling up the shallow trenches;

5 performing a chemical mechanical polishing (CMP) process to remove the silicon oxide layer above a top surface of the silicon nitride layer so that a top surface of the silicon oxide layer is aligned with the top surface of the silicon nitride layer; and

removing the silicon nitride layer.

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28. (Original) The method of claim 27 further comprising a step for forming a linear oxide layer in an inner surface of the shallow trenches after performing the isotropic etching process.

15 29. (Original) The method of claim 27 wherein a thickness of the silicon nitride layer removed by the isotropic etching process is 100 to 300 Å.

30. (Original) The method of claim 27 wherein the silicon oxide layer is formed by performing an atmospheric pressure chemical vapor deposition (APCVD) process.

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31. (Original) The method of claim 15 wherein to form the silicon oxide layers having the tops in the shape of a mushroom is to prevent a kink effect.

32. (Original) The method of claim 15 wherein the high voltage metal oxide  
25 semiconductor device is operated at +/- high voltage.

33. (Original) The method of claim 15 wherein the deep well region is used to prevent a

Appl. No. 10/707,444  
Amdt. dated August 31, 2005  
Reply to Office action of June 01, 2005

back bias effect when the high voltage metal oxide semiconductor device is operated at  
+/- high voltage.